CLAIMS

1. A method for forming an LED, the method comprising bonding a heat generating region of a light emitting device to a heat conductive substrate so as to define a composite structure and so as to substantially enhance heat dissipation from the light emitting device.

2. The method as recited in claim 1, wherein bonding a heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region of a light emitting device directly to a heat conductive substrate.

3. The method as recited in claim 1, wherein bonding the heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region comprising the following to the heat conductive substrate:
   an active layer;
   an n-doped layer; and
   a p-doped layer.

4. The method as recited in claim 1, wherein bonding the heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region comprising the following to the heat conductive substrate:
   an active layer;
   an n-doped layer,
   a p-doped layer; and
   metal bonding layer.

5. The method as recited in claim 1, wherein bonding the heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region comprising the following to the heat conductive substrate:
   a transparent substrate;
   an active layer;
   an n-doped layer,

a p-doped layer; and
metal bonding layer.

6. The method as recited in claim 1, wherein bonding the heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region comprising the following to the heat conductive substrate:

an active layer;
an n-doped layer;
a p-doped layer,
a reflector layer ; and
metal bonding layer.

7. The method as recited in claim 1, wherein bonding the heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region comprising the following to the heat conductive substrate:

a transparent substrate;
an active layer;
an n-doped layer;
a p-doped layer,
a reflector layer ; and
metal bonding layer.

8. The method as recited in claim 1, wherein bonding the heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region directly to a heat conductive substrate comprising:

a silicon layer; and
a metal bonding layer.

9. The method as recited in claim 1, wherein the heat generating region of the light emitting device comprises:

a transparent substrate;
an active layer;
an n-doped layer;

a p-doped layer,

a reflector layer ;

metal bonding layer;

and the heat conductive substrate comprises:

a silicon layer; and

a metal bonding layer.

10. The method as recited in claim 1, wherein the heat generating region of the light emitting device comprises a metal bonding layer and the heat conductive substrate comprises a metal bonding layer and further comprising cleaning both metal bonding layers prior to bonding the heat generating region of a light emitting device to the heat conductive substrate.

11. The method as recited in claim 1, wherein bonding a heat generating region of a light emitting device to a heat conductive substrate comprises bonding a plurality of light emitting devices to a single heat conductive substrate.

12. The method as recited in claim 1, wherein bonding a heat generating region of a light emitting device to a heat conductive substrate comprises bonding a plurality of light emitting devices of a single color to a single heat conductive substrate.

13. The method as recited in claim 1, wherein bonding a heat generating region of a light emitting device to a heat conductive substrate comprises bonding a heat generating region of a light emitting device to a heat conductive substrate using a wafer bonding fixture.

14. The method as recited in claim 1, wherein the light emitting device comprises a transparent substrate and the transparent substrate comprises at least one material selected from the group consisting of:

ZnO;

Sapphire

Spinel;

MgO;

GaN;

AlN;

AlGaN; and

AlInGaN.

15. The method as recited in claim 1, wherein the light emitting device comprises:

    an n type semiconductor material; and

    a p type semiconductor material disposed proximate the n type semiconductor material so as to define an active layer.

16. The method as recited in claim 1, wherein the light emitting device comprises:

    n type gallium nitride; and

    p type gallium nitride disposed proximate the n type gallium nitride so as to define an active layer.

17. The method as recited in claim 1, wherein the light emitting device comprises n type gallium nitride, p type gallium nitride disposed proximate the n type gallium nitride so as to define an active layer, and wherein the active layer comprises at least one structure selected from the list consisting of:

    a double heterostructure;

    a single quantum well structure; and

    a multiple quantum well structure.

18. The method as recited in claim 1, further comprising forming an n-electrode and a p-electrode on the same side of the composite structure.

19. The method as recited in claim 1, wherein the light emitting device comprises a reflector layer comprising a metal layer comprising one of the Al, Ag, Au, Cr.

20. The method as recited in claim 1, wherein the light emitting device comprises a metal bonding layer which comprises a metal selected from the group consisting of:

    Ni;

    Pt;

Au; and

Ti.

21. The method as recited in claim 1, wherein the heat conductive substrate comprises a material selected from the group consisting of:

silicon;

Ge;

SiC;

GaAs;

InP;

GaP

ZnO; and

a metal.

22. The method as recited in claim 1, further comprising forming an n electrode upon the composite device.

23. The method as recited in claim 1, further comprising forming a passivation layer upon the composite device.

24. The method as recited in claim 1, further comprising forming positive and negative bonding pads upon the composite device.

25. An LED comprising a light emitting device having a heat generating region and a heat conductive substrate to which the heat generating region is bonded, so as to define a composite structure and so as to substantially enhance heat dissipation from the light emitting device.

26. The LED as recited in claim 25 , wherein the heat generating region of the light emitting device is bonded directly to the heat conductive substrate.

27. The LED as recited in claim 25 , wherein the heat generating region comprises:

an active layer;

an n-doped layer; and

a p-doped layer.

28. The LED as recited in claim 25 , wherein the heat generating region comprises:

    an active layer;

    an n-doped layer;

    a p-doped layer; and

    metal bonding layer.

29. The LED as recited in claim 25 , wherein the heat generating region comprises:

    a transparent substrate;

    an active layer;

    an n-doped layer,

    a p-doped layer; and

    metal bonding layer.

30. The LED as recited in claim 25 , wherein the heat generating region comprises:

    an active layer;

    an n-doped layer;

    a p-doped layer,

    a reflector layer ; and

    metal bonding layer.

31. The LED as recited in claim 25 , wherein the heat generating region comprises:

    a transparent substrate;

    an active layer;

    an n-doped layer;

    a p-doped layer;

    a reflector layer; and

    metal bonding layer.

32. The LED as recited in claim 25 , wherein the heat conductive substrate comprises:

    a silicon layer; and

a metal bonding layer.

33. The LED as recited in claim 25 , wherein the heat generating region of the light emitting device comprises:

a transparent substrate;

an active layer;

an n-doped layer;

a p-doped layer;

a reflector layer ;

metal bonding layer;

the heat conductive substrate comprises:

a silicon layer; and

a metal bonding layer.

34. The LED as recited in claim 25 , wherein the heat generating region of the light emitting device comprises a metal bonding layer and the heat conductive substrate comprises a metal bonding layer.

35. The LED as recited in claim 25 , wherein a plurality of light emitting devices are bonded to a single heat conductive substrate.

36. The LED as recited in claim 25 , wherein a plurality of light emitting devices of a single color devices are bonded to a single heat conductive substrate.

37. The LED as recited in claim 25 , wherein the light emitting device comprises a transparent substrate and the transparent substrate comprises at least one material selected from the group consisting of:

ZnO;

Sapphire;

Spinel;

MgO;

GaN;

AlN;

AlGaN; and

AlInGaN.

38. The LED as recited in claim 25 , wherein the light emitting device comprises:

an n type semiconductor material; and

a p type semiconductor material disposed proximate the n type semiconductor material so as to define an active layer.

39. The LED as recited in claim 25 , wherein the light emitting device comprises:

n type gallium nitride; and

p type gallium nitride disposed proximate the n type gallium nitride so as to define an active layer.

40. The LED as recited in claim 25 , wherein the light emitting device comprises n type gallium nitride, p type gallium nitride disposed proximate the n type gallium nitride so as to define an active layer, and wherein the active layer comprises at least one structure selected from the list consisting of:

a double heterostructure;

a single quantum well structure; and

a multiple quantum well structure.

41. The LED as recited in claim 25 , further comprising an electrode formed upon the composite structure.

42. The LED as recited in claim 25 , further comprising an electrode of p type semiconductor material formed upon the composite structure.

43. The LED as recited in claim 25 , wherein the light emitting device comprises a reflector comprising a metal layer that comprises one of the Al, Ag, Au, Cr.

44. The LED as recited in claim 25 , wherein the light emitting device comprises a metal bonding layer which comprises a metal selected from the group consisting of:

Ni;

Pt;

Au; and

Ti.

45. The LED as recited in claim 25 , wherein the heat conductive substrate comprises a material selected from the group consisting of:

silicon;

Ge;

SiC;

GaAs;

InP;

GaP;

ZnO; and

a metal.

46. The LED as recited in claim 25 , further comprising an n electrode formed upon the composite device.

47. The LED as recited in claim 25 , further comprising a passivation layer formed upon the composite device.

48. The LED as recited in claim 25 , further comprising positive and negative bonding pads formed upon the composite device.

49. An LED chip comprising a conductive substrate formed generally at one surface thereof, a transparent emitting substrate formed generally at another surface thereof and attached thereto by a direct wafer bonding technique, and backside via contacts.

50. The LED chip as recited in claim 49 , wherein the conductive substrate comprises at least one material selected from the group consisting of:

Si;

Ge;

SiC;

GaAs;

InP;

GaP;

ZnO; and

metal substrates.

51. The LED chip as recited in claim 49, wherein the transparent substrate comprises at least one material selected from the group consisting of:

sapphire;

spinel;

ZnO;

SiC;

MgO;

GaN;

AlN;

AlGaN; and

AlInGaN.

52. A reflective electrode comprising a single layer of reflective material formed upon p type gallium nitride layer, an n+ type gallium nitride interlayer form intermediate the reflective material and the p type gallium nitride layer, and at least one ohmic contact layer formed to the p type gallium nitride layer.

53. A reflective electrode comprising a plurality of layers of reflective material formed upon p type gallium nitride layer, an n+ type gallium nitride interlayer form intermediate the reflective material and the p type gallium nitride layer, and at least one ohmic contact layer formed to the p type gallium nitride layer.